

LISTING OF THE CLAIMS

1. (Currently Amended) An oil pump rotor assembly comprising:
an inner rotor having “n” external teeth (“n” is a natural number); ~~and~~
an outer rotor having (n+1) internal teeth which are engageable with the external teeth;
and
the distance between an apex of an outer tooth of the inner rotor and an apex of an inner tooth of the outer rotor when the apexes oppose each other defining a tip clearance therebetween,

wherein the oil pump rotor assembly is used in an oil pump which further includes a casing having a suction port for drawing fluid and a discharge port for discharging fluid, and which conveys fluid by drawing and discharging fluid by volume change of cells formed between tooth surfaces of the inner rotor and the outer rotor during relative rotation between the inner rotor and the outer rotor engaging each other,

wherein each of the tooth profiles of the outer rotor is formed such that the tooth space profile thereof is formed using an epicycloid curve which is generated by rolling a circumscribed-rolling circle A_o along a base circle D_o without slip, and the tooth tip profile thereof is formed using a hypocycloid curve which is generated by rolling an inscribed-rolling circle B_o along the base circle D_o without slip,

wherein the tooth space profile of the inner rotor is formed based on a hypocycloid curve which is formed by rolling an inscribed-rolling circle B_i along a base circle D_i without slip, ~~and~~

wherein the tooth tip profile of the inner rotor is formed such that an epicycloid curve, which is generated by rolling a circumscribed-rolling circle A_i along the base circle D_i without slip,

is equally divided into two at a midpoint thereof to obtain two outer tooth curve segments, and the two outer tooth curve segments are separated by a predetermined distance and are smoothly connected to each other using a curve or a straight line, and

wherein the predetermined distance between the two outer tooth curve segments is designated by “ α ”, and the tip clearance is designated by “ t ”, “ α ” is set so as to satisfy the following inequalities:

$$\underline{t/4 \leq \alpha \leq 3t/4}.$$

2. (Original) An oil pump rotor assembly according to claim 1, wherein the separation of the two outer tooth curve segments is performed in such a manner that the two outer tooth curve segments are moved along the circumference of the base circle D_i .

3. (Withdrawn) An oil pump rotor assembly according to claim 1, wherein the separation of the two outer tooth curve segments is performed in such a manner that the two outer tooth curve segments are moved in the direction of a tangent of the epicycloid curve drawn at the midpoint thereof.

4. (Withdrawn) An oil pump rotor assembly according to claim 1, wherein the separation of the two outer tooth curve segments is performed in such a manner that the two outer tooth curve segments are first moved along the circumference of the base circle D_i , and then moved in the direction of a tangent of the epicycloid curve drawn at the midpoint thereof.

5. (Withdrawn) An oil pump rotor assembly according to claim 1, wherein the separation of the two outer tooth curve segments is performed in such a manner that the two outer tooth curve segments are first moved in the direction of a tangent of the epicycloid curve drawn at the midpoint thereof, and then moved along the circumference of the base circle Di.

6. (Canceled)

7. (Withdrawn) An oil pump rotor assembly according to claim 6, wherein the predetermined distance “ α ” is set so as to satisfy the following inequalities:

$$2t/5 \leq \alpha \leq 3t/5.$$

8. (Currently Amended) An oil pump rotor assembly comprising:

an inner rotor having “n” external teeth (“n” is a natural number); and

an outer rotor having (n+1) internal teeth which are engageable with the external teeth;

and

the distance between an apex of an outer tooth of the inner rotor and an apex of an inner tooth of the outer rotor when the apexes oppose each other defining a tip clearance therebetween,

wherein the oil pump rotor assembly is used in an oil pump which further includes a casing having a suction port for drawing fluid and a discharge port for discharging fluid, and which conveys fluid by drawing and discharging fluid by volume change of cells formed between tooth surfaces of the inner rotor and the outer rotor during relative rotation between the inner rotor and the outer rotor engaging each other,

wherein each of the tooth profiles of the inner rotor is formed such that the tooth tip profile thereof is formed using an epicycloid curve which is generated by rolling a circumscribed-rolling circle A_i along a base circle D_i without slip, and the tooth space profile thereof is formed using a hypocycloid curve which is generated by rolling an inscribed-rolling circle B_i along the base circle D_i without slip,

wherein the tooth space profile of the outer rotor is formed based on an epicycloid curve which is formed by rolling a circumscribed-rolling circle A_o along a base circle D_o without slip, and

wherein the tooth tip profile of the outer rotor is formed such that a hypocycloid curve, which is generated by rolling an inscribed-rolling circle B_o along the base circle D_o without slip, is equally divided into two at a midpoint thereof to obtain two inner tooth curve segments, and the two inner tooth curve segments are separated by a predetermined distance and are smoothly connected to each other using a curve or a straight line, and

wherein the predetermined distance between the two inner tooth curve segments is designated by " β ", and the tip clearance is designated by " t ", " β " is set so as to satisfy the following inequalities:

$$t/4 \leq \beta \leq 3t/4.$$

9. (Original) An oil pump rotor assembly according to claim 8, wherein the separation of the two inner tooth curve segments is performed in such a manner that the two inner tooth curve segments are moved along the circumference of the base circle D_o .

10. (Withdrawn) An oil pump rotor assembly according to claim 8, wherein the separation of the two inner tooth curve segments is performed in such a manner that the two inner tooth curve segments are moved in the direction of a tangent of the hypocycloid curve drawn at the midpoint thereof.

11. (Withdrawn) An oil pump rotor assembly according to claim 8, wherein the separation of the two inner tooth curve segments is performed in such a manner that the two inner tooth curve segments are first moved along the circumference of the base circle Do, and then moved in the direction of a tangent of the hypocycloid curve drawn at the midpoint thereof.

12. (Withdrawn) An oil pump rotor assembly according to claim 8, wherein the separation of the two inner tooth curve segments is performed in such a manner that the two inner tooth curve segments are first moved in the direction of a tangent of the hypocycloid curve drawn at the midpoint thereof, and then moved along the circumference of the base circle Do.

13. (Canceled)

14. (Withdrawn) An oil pump rotor assembly according to claim 13, wherein the predetermined distance “ β ” is set so as to satisfy the following inequalities:

$$2t/5 \leq \beta \leq 3t/5.$$

15. (Currently Amended) An oil pump rotor assembly comprising:

an inner rotor having “n” external teeth (“n” is a natural number); ~~and~~
an outer rotor having (n+1) internal teeth which are engageable with the external teeth;
and
the distance between an apex of an outer tooth of the inner rotor and an apex of an inner tooth of the outer rotor when the apexes oppose each other defining a tip clearance therebetween,

wherein the oil pump rotor assembly is used in an oil pump which further includes a casing having a suction port for drawing fluid and a discharge port for discharging fluid, and which conveys fluid by drawing and discharging fluid by volume change of cells formed between tooth profiles of the inner rotor and the outer rotor during relative rotation between the inner rotor and the outer rotor engaging each other,

wherein the tooth tip profile of the inner rotor is formed such that an epicycloid curve, which is generated by rolling a circumscribed-rolling circle A_i along a base circle D_i without slip, is equally divided into two at a midpoint thereof to obtain two outer tooth curve segments, and the two outer tooth curve segments are separated by a predetermined distance and are smoothly connected to each other using a curve or a straight line,

wherein the tooth space profile of the inner rotor is formed based on a hypocycloid curve which is formed by rolling an inscribed-rolling circle B_i along the base circle D_i without slip,

wherein the tooth space profile of the outer rotor is formed based on an epicycloid curve which is formed by rolling a circumscribed-rolling circle A_o along a base circle D_o without slip,
~~and~~

wherein the tooth tip profile of the outer rotor is formed such that a hypocycloid curve, which is generated by rolling an inscribed-rolling circle B_o along the base circle D_o without slip, is

equally divided into two at a midpoint thereof to obtain two inner tooth curve segments, and the inner tooth curve segments are separated by a predetermined distance and are smoothly connected to each other using a curve or a straight line, and

wherein the predetermined distance between the two outer tooth curve segments is designated by “ α ”, the predetermined distance between the two inner tooth curve segments is designated by “ β ”, and the tip clearance is designated by “ t ”, “ α ” and “ β ” are set so as to satisfy the following inequalities:

$$t/4 \leq \alpha \leq 3t/4; \text{ and}$$

$$t/4 \leq \beta \leq 3t/4.$$

16. (Original) An oil pump rotor assembly according to claim 15, wherein the separation of the two outer tooth curve segments is performed in such a manner that the two outer tooth curve segments are moved along the circumference of the base circle D_i , and the separation of the two inner tooth curve segments is performed in such a manner that the two inner tooth curve segments are moved along the circumference of the base circle D_o .

17. (Withdrawn) An oil pump rotor assembly according to claim 15, wherein the separation of the two outer tooth curve segments is performed in such a manner that the two outer tooth curve segments are moved in the direction of a tangent of the epicycloid curve drawn at the midpoint thereof, the separation of the two inner tooth curve segments is performed in such a manner that the two inner tooth curve segments are moved in the direction of a tangent of the hypocycloid curve drawn at the midpoint thereof.

18. (Withdrawn) An oil pump rotor assembly according to claim 15, wherein the separation of the two outer tooth curve segments is performed in such a manner that the two outer tooth curve segments are first moved along the circumference of the base circle D_i , and then moved in the direction of a tangent of the epicycloid curve drawn at the midpoint thereof, and the separation of the two inner tooth curve segments is performed in such a manner that the two inner tooth curve segments are first moved along the circumference of the base circle D_o , and then moved in the direction of a tangent of the hypocycloid curve drawn at the midpoint thereof.

19. (Withdrawn) An oil pump rotor assembly according to claim 15, wherein the separation of the two outer tooth curve segments is performed in such a manner that the two outer tooth curve segments are first moved in the direction of a tangent of the epicycloid curve drawn at the midpoint thereof, and then moved along the circumference of the base circle D_i , and the separation of the two inner tooth curve segments is performed in such a manner that the two inner tooth curve segments are first moved in the direction of a tangent of the hypocycloid curve drawn at the midpoint thereof, and then moved along the circumference of the base circle D_o .

20. (Canceled)

21. (Withdrawn) An oil pump rotor assembly according to claim 20, wherein the predetermined distance " α " and the predetermined distance " β " are set so as to satisfy the following inequalities:

$$2t/5 \leq \alpha \leq 3t/5; \text{ and}$$

$$2t/5 \leq \beta \leq 3t/5.$$

22. (Previously presented) An oil pump rotor assembly according to claim 1, wherein the inner rotor and the outer rotor are formed such that the following equations are satisfied:

$$\phi A_i + t/2 = \phi A_o;$$

$$\phi B_i - t/2 = \phi B_o;$$

$$\phi A_i + \phi B_i = \phi A_o + \phi B_o = 2e;$$

$$\phi D_i = n \cdot (\phi A_i + \phi B_i);$$

$$\phi D_o = (n+1) \cdot (\phi A_o + \phi B_o); \text{ and}$$

$$(n+1) \cdot \phi D_i = n \cdot \phi D_o,$$

where, ϕD_i is the diameter of the base circle D_i of the inner rotor, ϕA_i is the diameter of the circumscribed-rolling circle A_i , ϕB_i is the diameter of the inscribed-rolling circle B_i , ϕD_o is the diameter of the base circle D_o of the outer rotor, ϕA_o is the diameter of the circumscribed -rolling circle A_o , ϕB_o is the diameter of the inscribed-rolling circle B_o , “e” is an eccentric distance between the inner rotor and the outer rotor, and “t” is a tip clearance.

23. (Previously presented) An oil pump rotor assembly according to claim 1, wherein the inner rotor and the outer rotor are formed such that the following equations are satisfied:

$$\phi A_i + t/(n+2) = \phi A_o;$$

$$\phi B_i = \phi B_o;$$

$$\phi A_i + \phi B_i = 2e;$$

$$\phi Di = n \cdot (\phi Ai + \phi Bi); \text{ and}$$

$$\phi Do = \phi Di \cdot (n+1)/n + t \cdot (n+1)/(n+2),$$

where, ϕDi is the diameter of the base circle Di of the inner rotor, ϕAi is the diameter of the circumscribed-rolling circle Ai , ϕBi is the diameter of the inscribed-rolling circle Bi , ϕDo is the diameter of the base circle Do of the outer rotor, ϕAo is the diameter of the circumscribed-rolling circle Ao , ϕBo is the diameter of the inscribed-rolling circle Bo , “e” is an eccentric distance between the inner rotor and the outer rotor, and “t” is a tip clearance.

24. (Previously presented) An oil pump rotor assembly according to claim 1, wherein the inner rotor and the outer rotor are formed such that the following equations are satisfied:

$$\phi Ai = \phi Ao;$$

$$\phi Bi + t/(n+2) = \phi Bo;$$

$$\phi Ai + \phi Bi = 2e;$$

$$\phi Di = n \cdot (\phi Ai + \phi Bi); \text{ and}$$

$$\phi Do = \phi Di \cdot (n+1)/n + t \cdot (n+1)/(n+2),$$

where, ϕDi is the diameter of the base circle Di of the inner rotor, ϕAi is the diameter of the circumscribed-rolling circle Ai , ϕBi is the diameter of the inscribed-rolling circle Bi , ϕDo is the diameter of the base circle Do of the outer rotor, ϕAo is the diameter of the circumscribed-rolling circle Ao , ϕBo is the diameter of the inscribed-rolling circle Bo , “e” is an eccentric distance between the inner rotor and the outer rotor, and “t” is a tip clearance.

25. (Previously presented) An oil pump rotor assembly according to claim 8, wherein the inner rotor and the outer rotor are formed such that the following equations are satisfied:

$$\phi A_i + t/2 = \phi A_o;$$

$$\phi B_i - t/2 = \phi B_o;$$

$$\phi A_i + \phi B_i = \phi A_o + \phi B_o = 2e;$$

$$\phi D_i = n \cdot (\phi A_i + \phi B_i);$$

$$\phi D_o = (n+1) \cdot (\phi A_o + \phi B_o); \text{ and}$$

$$(n+1) \cdot \phi D_i = n \cdot \phi D_o,$$

where, ϕD_i is the diameter of the base circle D_i of the inner rotor, ϕA_i is the diameter of the circumscribed-rolling circle A_i , ϕB_i is the diameter of the inscribed-rolling circle B_i , ϕD_o is the diameter of the base circle D_o of the outer rotor, ϕA_o is the diameter of the circumscribed-rolling circle A_o , ϕB_o is the diameter of the inscribed-rolling circle B_o , “e” is an eccentric distance between the inner rotor and the outer rotor, and “t” is a tip clearance.

26. (Previously presented) An oil pump rotor assembly according to claim 15, wherein the inner rotor and the outer rotor are formed such that the following equations are satisfied:

$$\phi A_i + t/2 = \phi A_o;$$

$$\phi B_i - t/2 = \phi B_o;$$

$$\phi A_i + \phi B_i = \phi A_o + \phi B_o = 2e;$$

$$\phi D_i = n \cdot (\phi A_i + \phi B_i);$$

$$\phi D_o = (n+1) \cdot (\phi A_o + \phi B_o); \text{ and}$$

$$(n+1) \cdot \phi D_i = n \cdot \phi D_o,$$

where, ϕD_i is the diameter of the base circle D_i of the inner rotor, ϕA_i is the diameter of the circumscribed-rolling circle A_i , ϕB_i is the diameter of the inscribed-rolling circle B_i , ϕD_o is the diameter of the base circle D_o of the outer rotor, ϕA_o is the diameter of the circumscribed-rolling circle A_o , ϕB_o is the diameter of the inscribed-rolling circle B_o , “e” is an eccentric distance between the inner rotor and the outer rotor, and “t” is a tip clearance.

27. (Previously presented) An oil pump rotor assembly according to claim 8, wherein the inner rotor and the outer rotor are formed such that the following equations are satisfied:

$$\phi A_i + t/(n+2) = \phi A_o;$$

$$\phi B_i = \phi B_o;$$

$$\phi A_i + \phi B_i = 2e;$$

$$\phi D_i = n \cdot (\phi A_i + \phi B_i); \text{ and}$$

$$\phi D_o = \phi D_i \cdot (n+1)/n + t \cdot (n+1)/(n+2),$$

where, ϕD_i is the diameter of the base circle D_i of the inner rotor, ϕA_i is the diameter of the circumscribed-rolling circle A_i , ϕB_i is the diameter of the inscribed-rolling circle B_i , ϕD_o is the diameter of the base circle D_o of the outer rotor, ϕA_o is the diameter of the circumscribed-rolling circle A_o , ϕB_o is the diameter of the inscribed-rolling circle B_o , “e” is an eccentric distance between the inner rotor and the outer rotor, and “t” is a tip clearance.

28. (Previously presented) An oil pump rotor assembly according to claim 15, wherein the inner rotor and the outer rotor are formed such that the following equations are satisfied:

$$\phi A_i + t/(n+2) = \phi A_o;$$

$$\phi B_i = \phi B_o;$$

$$\phi A_i + \phi B_i = 2e;$$

$$\phi D_i = n \cdot (\phi A_i + \phi B_i); \text{ and}$$

$$\phi D_o = \phi D_i \cdot (n+1)/n + t \cdot (n+1)/(n+2),$$

where, ϕD_i is the diameter of the base circle D_i of the inner rotor, ϕA_i is the diameter of the circumscribed-rolling circle A_i , ϕB_i is the diameter of the inscribed-rolling circle B_i , ϕD_o is the diameter of the base circle D_o of the outer rotor, ϕA_o is the diameter of the circumscribed-rolling circle A_o , ϕB_o is the diameter of the inscribed-rolling circle B_o , “e” is an eccentric distance between the inner rotor and the outer rotor, and “t” is a tip clearance.

29. (Previously presented) An oil pump rotor assembly according to claim 8, wherein the inner rotor and the outer rotor are formed such that the following equations are satisfied:

$$\phi A_i = \phi A_o;$$

$$\phi B_i + t/(n+2) = \phi B_o;$$

$$\phi A_i + \phi B_i = 2e;$$

$$\phi D_i = n \cdot (\phi A_i + \phi B_i); \text{ and}$$

$$\phi D_o = \phi D_i \cdot (n+1)/n + t \cdot (n+1)/(n+2),$$

where, ϕD_i is the diameter of the base circle D_i of the inner rotor, ϕA_i is the diameter of the circumscribed-rolling circle A_i , ϕB_i is the diameter of the inscribed-rolling circle B_i , ϕD_o is the diameter of the base circle D_o of the outer rotor, ϕA_o is the diameter of the circumscribed-rolling circle A_o , ϕB_o is the diameter of the inscribed-rolling circle B_o , “e” is an eccentric distance between the inner rotor and the outer rotor, and “t” is a tip clearance.

30. (Previously presented) An oil pump rotor assembly according to claim 15, wherein the inner rotor and the outer rotor are formed such that the following equations are satisfied:

$$\phi A_i = \phi A_o;$$

$$\phi B_i + t/(n+2) = \phi B_o;$$

$$\phi A_i + \phi B_i = 2e;$$

$$\phi D_i = n \cdot (\phi A_i + \phi B_i); \text{ and}$$

$$\phi D_o = \phi D_i \cdot (n+1)/n + t \cdot (n+1)/(n+2),$$

where, ϕD_i is the diameter of the base circle D_i of the inner rotor, ϕA_i is the diameter of the circumscribed-rolling circle A_i , ϕB_i is the diameter of the inscribed-rolling circle B_i , ϕD_o is the diameter of the base circle D_o of the outer rotor, ϕA_o is the diameter of the circumscribed-rolling circle A_o , ϕB_o is the diameter of the inscribed-rolling circle B_o , “e” is an eccentric distance between the inner rotor and the outer rotor, and “t” is a tip clearance.